The Windproof Srayer and The Opportunities it Presents

By R Barry Rogers P Eng. President of Rogers Engineering Inc.

Farmers, custom applicators, and researchers have long recognized that wind and drift, which have been synonymous up until now, are the main limitations to spraying. They force the farmer to rise at **4 a.m.** and spray frantically for a few hours before the wind comes up. The evening is a repeat of a few hours spraying at sunset to utilize the **short low wind period.** Often, the farmer cannot apply his chemical, which is returned to the supplier for refund and storage until next year, plus the farmer suffers a loss to weed infestation.

Some relief from the drift problem was gained by using large drops and high carrier volumes. But the efficacy of many of today's chemicals is reduced by **excessive dilution** and large drops that **reduce coverage** . In addition, it costs time and money to haul the extra water needed for high volume applications. All nozzles produce a certain percentage of **driftable drops** (those drops below 200 µm) which, on conventional sprayers, end up as drift, even in moderate winds. Thus, the farmer has to restrict his spraying to the early morning or late evening when winds are low. Often, the **prime killing stage** is **missed** because of extended wind delays. Farmers are often forced to spray early, late or in excessive winds, creating large amounts of drift, killing neighbouring crops and often coating the farmer and assistant with **toxic** herbicide, making them **sick** for weeks after the spraying season.

The Windproof

The **Windproof** Sprayer (patent pd.) with its aerodynamically designed enclosure contains the drift, making it not only safe, but efficient to spray on windy days. The enclosure is sealed to the crop surface with a double panelled sealing curtain, which creates a contained environment to spray in. The curtain also restricts the air flow under the enclosure, and thus the movement of driftable drops out of the enclosure. On a simple shroud, a frontal jet stream racing over the top creates a low pressure area and a reversed eddy behind the enclosure, which lifts drops out of the crop canopy and flips them up into the air (see Fig.#1). In the **Windproof's** design, an air foil is used to redirect that jet stream down the back, filling the low pressure area and eliminating the reversed currents behind the enclosure, giving the drops in the crop canopy time to deposit on the plants or soil (see Fig.#2).

The Saskatchewan Research Council was commissioned to drift test the **Windproof** and found that **off-target deposit** (approx. 80% of drift is deposited in the first 10 meters off-swath, and is referred to as off-target deposit) is held to a very low **0.4% regardless of wind.** The sprayer was equipped with 11001 tips, which produced 40% of their drops under 200 µm whereas the 8002 produces 3% under 200 µm. Only 1% of the **Windproof's** driftable drops became drift, whereas almost 100% of an 8002's became drift in a 27 km wind. Drift tests on the sprayer showed **no increase in off-target deposit** as winds climbed to 27 km/hr, the highest wind speed during the test period (see Fig.3)

The **double panelled** front curtain, which seals the leading edge of the enclosure, also bends tall weeds, such as **Canada Thistle**, exposing and covering the bottom side of the leaves with chemical. The underside of the leaf absorbs chemical easily, thus an increased amount of chemical **imbibed** by the plant. The curtain releases the plants just as the spray hits them. This increases plant movement, and along with the **air turbulence** created by the **spray jet** inside the shroud, greatly **increases coverage, and thus control**, especially for chemicals that need to get on to the **growing point** in order to kill. The wiping effect of the rear curtain increases the chemical distribution over the plants, especially large plants. The small drops

that may become drift from other sprayers are used by the **Windproof** to increase coverage and kill, which translates into **increased efficacy.**

The rear double panelled curtain seals the enclosure to the crop canopy, leaving only a small air space between it and the ground. Thus any drops leaving the enclosure are required to be very close to the ground. Being so close to the ground, they land on plants or soil. The curtain is slit into staggered panels to allow the curtain to **form around plants** etc., greatly improving the seal with the crop canopy. The second row of panels forces all drops attempting to escape through the slits in the first row to make two right angle turns, which causes them to **impinge on the curtain**, preventing them from escaping into the atmosphere. The chemical on the curtain is quickly wiped on to the leaves, increasing the coverage, especially on larger plants.

The boom and shroud are supported by tandem beam outriggers every 5 meters, to ensure that the shroud is a constant height above ground. It folds back into transport with **Vertec's 90 sec. fold** system, similar to **Vertec's** traditional broadacre wheel boom sprayers. The nozzles spray approximately 40 degrees ahead to give improved coverage and penetration. **Bayonet mounted** nozzle caps on the diaphragm check valve nozzle assemblies make tip changes easy. Different nozzles can be used to give application rates from **10 l/ha** with **800040** tips to **150 l/ha** with **8002** tips; higher application rates can be applied with larger supply hoses and tips. An optional **individual nozzle flow indicator** checks each nozzle and displays the location of ones that have reduced flows or are plugged. Since the tips are not visable from the tractor seat, the farmers require the flow indicator to detect malfunctioning nozzles.

The **Windproof** dramatically changes application technology, by removing drift as a spray restraint. It mechanically controls drift. What opportunities does mechanical drift control give to reduce chemical application costs? First of all, let us look at the factors that affect chemical efficacy (efficacy means the ability to do something).

Factors Affecting Crop Protection Chemical's Efficacy

Drop Size

Reducing drop size has a cubed effect on coverage. When you divide a liter of liquid into drops, you get 9 million 600 µm drops (typical of today's sprayers) or 2 billion 100 µm drops. This is an increase of 216 times. Scientists have found that efficacy is more related to the number of drops per cm^2 than to the size of the drops. Smaller drops are necessary, if carrier volumes are reduced to maintain coverage.

100 µm drops are easily carried by the air and can be swirled around plants by air turbulence to increase coverage both on the top and bottom of the leaves.

Chemical Concentration

Increased concentration of adjuvants and solvents in the spray solution increase the drop's ability to stick to the leaf surface and weaken the leaf's wax seal, which increases chemical up-take by the plant. In some cases, too high a solvent strength will burn leaf edges, thus the solvent concentration needs to be considered carefully.

Plant Growth Stage & Vigour

Plants that are vigourously growing, especially in the early growth stages, absorb chemical applied to the leaf quicker and distribute it throughout the plant faster, thereby increasing both the speed of control and its total effect. Generally, hot, humid weather and fast growth greatly decrease the amount of chemical required to get control, whereas cold and/or dry conditions increase the amount to get control. Timing chemical application can greatly increase chemical control.

Air Temperature

The efficacy of many chemicals is affected by temperature. Barry Todd of the Manitoba Agriculture at their 1985 Weed Fairs talked on the influence of environmental factors on efficacy. Hoegrass's activity was increased by low temperatures, whereas Avenge was decreased. Temperature effect on efficacy is totally chemical dependent. More summaries, such as Todd's, are required to give the farmer a better picture of what makes his chemical work.

Nitrogen

Liquid nitrogen fertilizer enhances the efficacy of some chemicals apparently by both increasing up-take by carrying the chemical through the leaf surface into the plant and by the increased growth vigour, resulting from foliar applied nitrogen, especially Ammonia Sulfate.

Spray Directed 45^0 Ahead

When the nozzle is faced 45^0 degrees ahead, the spray sees a larger amount of the plant and more of the spray is captured by the plant. A recent Australian study showed an increase up to 186% on rye grass.

Billion Drop Technology

Billion Drop Technology is an emerging crop protection application technology that uses ultra small drops to increase coverage, allowing a decrease in carrier and chemical application rates. Drop size is synergistically combined with various other efficacy increasing factors ,previously mentioned, and has the **potential to reduce carrier rates by 80-90% to 1 to 2 gal per acre and possibly chemical rates by 50%.** Only parts of this technology have been defined by research to date. Much more of it needs to be defined and will require extensive research. I estimate that approximately **$5-10 million would need to be spent over the next 5 years to fully define this new technology, so that it could be utilized by all famrers.** Farmers, who are chemical and plant conscious, may be willing to try some experimenting themselves, but they must remember that there is no chemical warranty on chemicals that are applied at less than the recommended rates. This emerging technology will require a greater degree of management ability and awareness, but will also pay greater benefits.

Economic Impact

What does a **50%** reduction in active ingredients and a **90%** reduction in carrier mean? The three Canadian Prairie provinces apply about $300 million of postemergent herbicides. The potential saving in herbicides is approximately **$150 million** per year, plus the labour and energy to haul about **two billion** litres of water and to apply it to the soil. The saving is not only **in herbicide** but in weed loss avoidance, because the acres sprayed will increase with a reduction in the cost and convenience detriments - less water and more time flexibility make spraying faster and more convenient. The carrier reductions will make spraying easier for farmers in water problem areas and tank size will decrease to about 1500 litres (330 Imp. Gal. or 400 U.S. Gal.), because that tank size would do a half section, an equivalent in area to the largest sprayers available today, with reduced cost, plus less soil and plant compaction.

For the **farmer to benefit** from the introduction of the **Windproof** sprayer and other ultra small drop applicators, the **Billion Drop Technology** must be researched and developed. **$5 million for an annual return of $150 million** is one tremendous investment, not to mention the environmental advantages of applying less chemical and solvents to our fields.

The **Windproof Sprayer** with 20 meter booms and 2300 or 3600 litre tanks is available from:

Vertec Industries Ltd. Box 840,Vermilion, Alta.,T0B 4M0, Canada, Tel. 403-853-2901

Vertec Farm Equip. Ltd. Box 399, Mayville, N. Dakota, 58257 USA, Tel. 701-786-4057

Vertec Machinery Pty. Ltd. Box 656, Toowoomba, Queensland, 45350, Austrialia
Tel. 076-345-766

Windproof Plot & Custom Designed Sprayers are available in 2 meter **push type** and 6 meter **ATV or tractor drawn** models with CO_2 and pump pressure systems from;

Rogers Engineering Inc. 1510 Hilliard St. E., Saskatoon, Saskatchewan, S7J 0G4, Canada, Tel. 306-477-2667

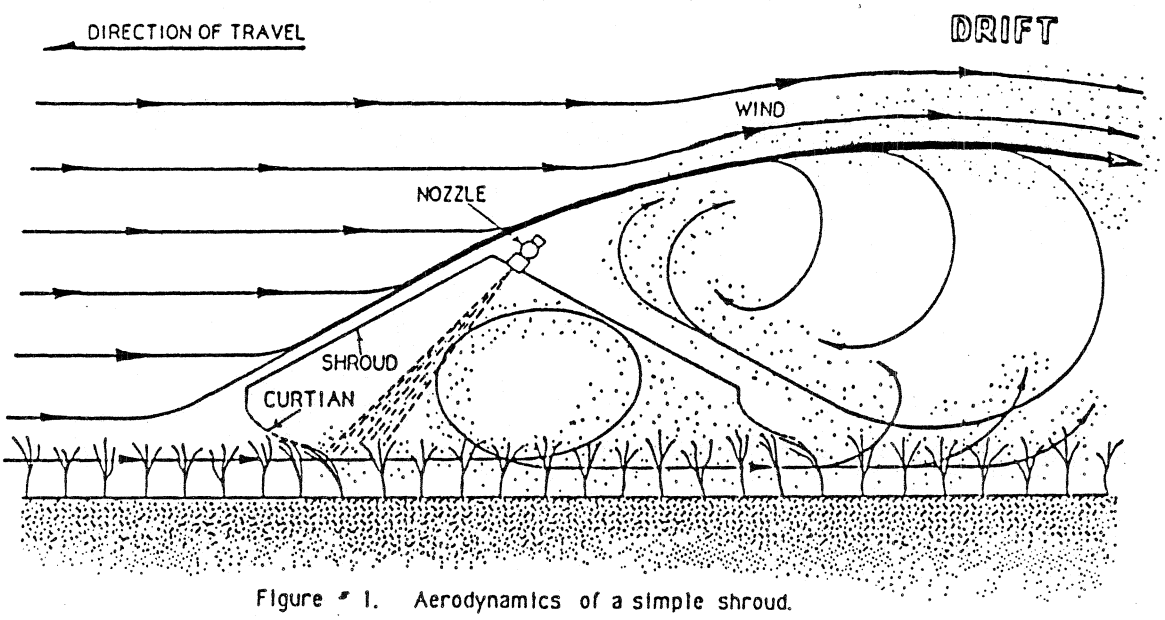


Figure # 1. Aerodynamics of a simple shroud.

PROJECT. SHROUDED SPRAYER PROJECT	*Rogers Engineering Inc.*	# 100

Innovation in Agriculture

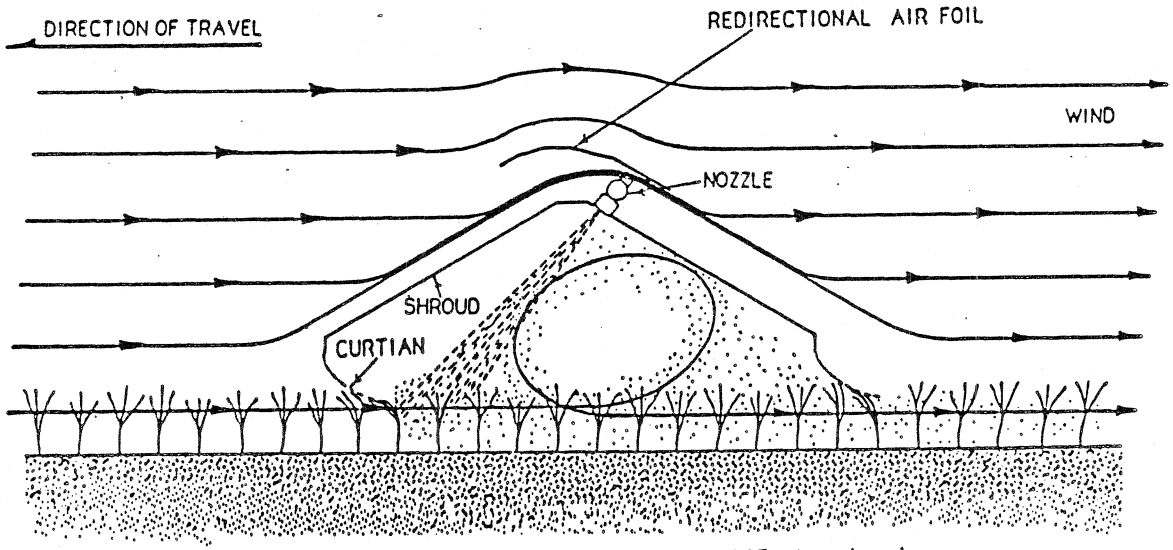
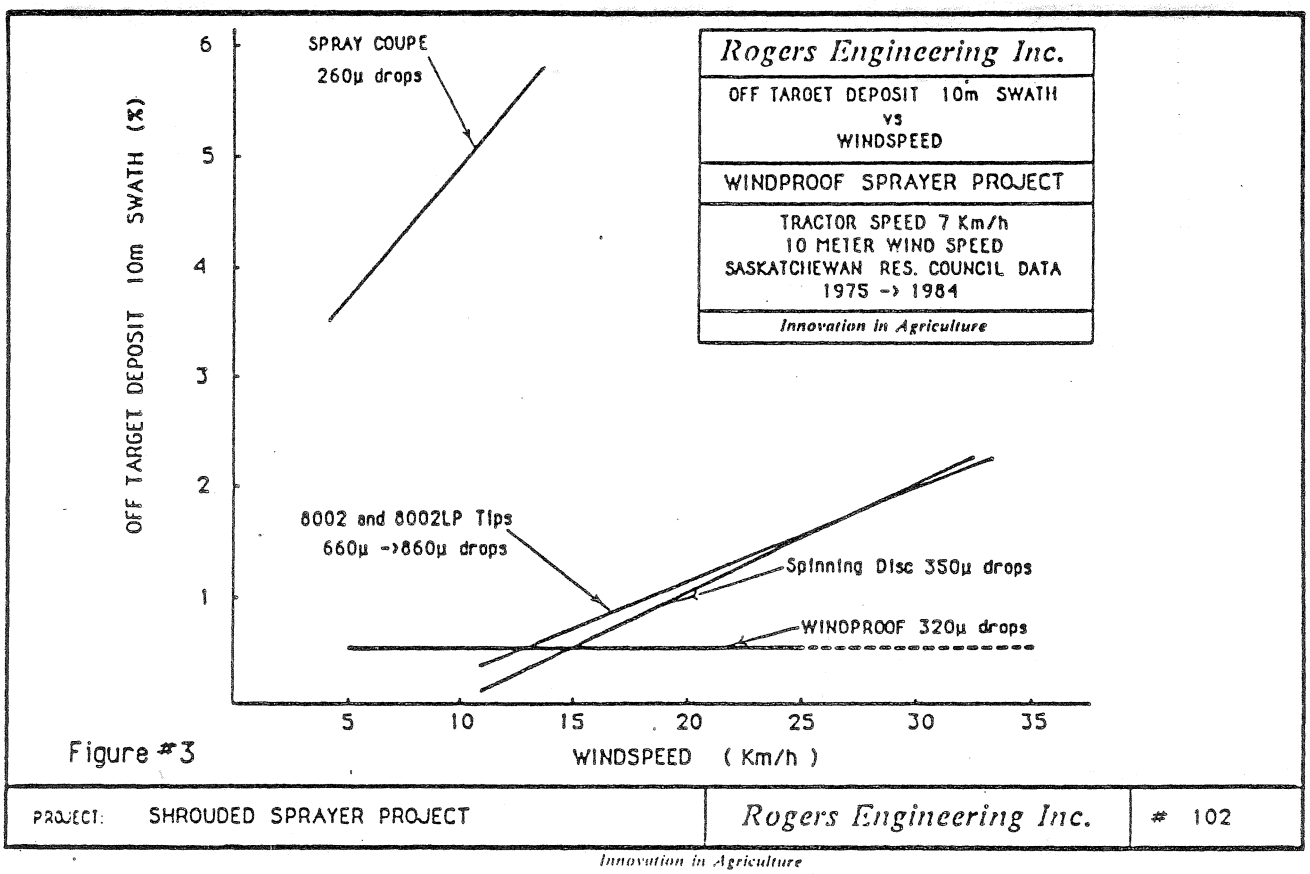


Figure # 2. Aerodynamics of the WINDPROOF shroud and redirectional air foil.

PROJECT. SHROUDED SPRAYER PROJECT	*Rogers Engineering Inc.*	# 101

Innovation in Agriculture


Rogers Engineering Inc.
OFF TARGET DEPOSIT 10m SWATH
vs
WINDSPEED
WINDPROOF SPRAYER PROJECT
TRACTOR SPEED 7 Km/h
10 METER WIND SPEED
SASKATCHEWAN RES. COUNCIL DATA
1975 -> 1984
Innovation in Agriculture
OFF TARGET DEPOSIT 10m SWATH (%)
SPRAY COUPE
260µ drops
8002 and 8002LP Tips
660µ ->860µ drops
Spinning Disc 350µ drops
WINDPROOF 320µ drops
WINDSPEED (Km/h)
Figure #3
PROJECT: SHROUDED SPRAYER PROJECT
Rogers Engineering Inc.
102
Innovation in Agriculture